

# Reducing Pathogen Transmission from Livestock Production to Food, Water, and the Environment

Elaine Berry and Jim Wells  
USDA, ARS, US Meat Animal Research Center  
Clay Center, Nebraska

Collaborative Approaches for Understanding and Managing  
Air and Water Quality Issues in Livestock Production  
October 13-14, 2010



## Reducing human foodborne bacterial pathogens in manure will reduce the risk of food- and waterborne illness by:

- Reduce water supply contamination by runoff from manure.
- Reduce food crop & water contamination when used as soil amendment or fertilizer.
- Reduce transmission among animals in the production environment.

### Two Approaches:

- Reduce pathogen colonization and shedding by the live animal.
- Treat or manage manures to reduce pathogens.

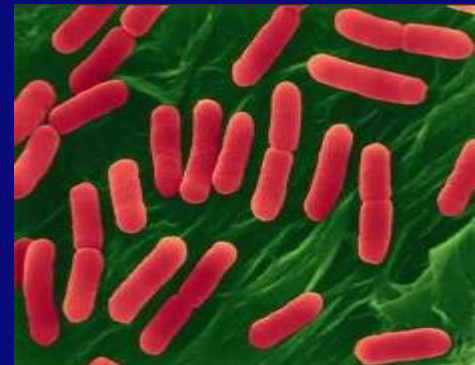


## Objectives:

- Identify the ecological and environmental factors that affect pathogen occurrence, survival, fate, and transport in animal production facilities and surrounding environments.
- Develop and evaluate strategies to reduce or eliminate the occurrence, persistence, or movement of foodborne pathogens among food animals, their environment, and surrounding production environments.

**Host species:** Cattle and swine

**Pathogen targets:** *E. coli* O157:H7 and other STEC, *Campylobacter* spp., and *Salmonella* spp.



# Recent Work

## Factors affecting pathogens:

- Effects of feeding wet distillers grains with solubles (WDGS) on *E. coli* O157:H7 prevalence and levels in cattle and persistence in manure.
- Determination of factors affecting pathogen shedding in growing pigs and nursery swine.
- Impact of cattle heat stress levels on fecal shedding of *E. coli* O157:H7.
- Pond ash vs. soil feedlot pen surfaces: effects on *E. coli* O157:H7 prevalence in cattle and persistence in manure.

## Strategies to control or reduce pathogens:

- Runoff control system with vegetative treatment area (VTA) for containing and removing pathogens from feedlot runoff.
- Phenolic compounds to control pathogens in cattle, on feedlot surfaces, and in swine manure.
- Reduction of naturally occurring *E. coli* O157:H7 during bovine manure composting processes.

# Current and Future Research

## Factors affecting pathogens:

- Determine if temperament, eating, and drinking behaviors of cattle impact *E. coli* O157:H7 colonization and/or shedding.
- Determine how the establishment and ecology of gastrointestinal microflora alters animal susceptibility to pathogens in young swine.
- Determine which and how components of distillers grain diets affect occurrence, levels, and persistence of pathogens in livestock and their manure.
- Determine the role of windborne bioaerosols in the transport of *E. coli* O157:H7 in and from cattle production environments.

## Strategies to control or reduce pathogens:

- Develop feedlot pen surface treatments to reduce pathogen occurrence and levels in beef cattle.
- Determine the influence of various crop- and wood-based bedding materials on *E. coli* levels in simulated bedded packs of cattle deep-bedded monoslope facilities.
- Develop minimally managed composting formats to improve pathogen inactivation from bovine feedlot manure.

Determine host genetic factors and GI ecology associated with *E. coli* O157:H7 colonization and shedding, and if eating and drinking behaviors, and temperament of cattle impact *E. coli* O157:H7 colonization and/or shedding.

When individual animals are sampled repeatedly for determination of the presence and levels of *E. coli* O157:H7, the distribution pattern indicates that a wide variation can be observed. The extremes may be a result of unique attributes of the individual animal. Thus, *E. coli* O157:H7 colonization, persistence of colonization, and magnitude of shedding may involve a number of host factors.

A large, multi-year study is examining the genetic basis for differences in the efficiency of nutrient utilization in beef cattle housed in the USMARC Feed Efficiency Facility. Determination of the host genetic basis for *E. coli* O157:H7 colonization and shedding in beef cattle will be done, as will the determination of gastrointestinal microbial ecology associated with *E. coli* O157:H7 colonization and shedding.

Data collected on these animals include eating & drinking behavior (e.g. numbers, frequency, and size of meals & drinking events, total feed & water intake) and temperament (chute scores and flight times).

## Determine how the establishment and ecology of gastrointestinal microflora alters animal susceptibility to pathogens in young swine.

We hypothesize that interventions in swine at early ages will minimize persistent pathogen colonization and shedding. Management decisions in production swine can alter the gastrointestinal microbial ecology and affect pathogen colonization and shedding.

- Susceptibility to colonization by *Campylobacter*, *Salmonella*, and STEC in piglets reared without antibiotics will be determined, and microbial profiles associated with presence or absence of pathogens will be determined.
- The impact of dietary lysozyme on *Campylobacter*, *Salmonella*, and STEC colonization of piglets will be examined.
- The effects of dietary antimicrobials (bacitracin, chlortetracycline and no antimicrobial) on *Campylobacter*, *Salmonella*, and STEC colonization of growing swine will be determined.



## Determine which and how components of distillers grain diets affect occurrence, levels, and persistence of pathogens in livestock and their manure.

The increase in *E. coli* O157:H7 fecal prevalence seen with WDGS was associated with increased number of animals shedding *E. coli* O157:H7 at enumerable levels, increased levels of generic *E. coli*, and changes in the fecal chemical composition. Increases in fecal prevalence could be a consequence of a component in distillers grains that expands the gastrointestinal niche that sustains *E. coli* O157:H7.

- Determine the effects of WDGS removal from the diet on the prevalence and levels of *E. coli* O157:H7 in feces and on hides of cattle.
- Determine if specific components of distillers grains or their metabolic by-products are responsible for the increased levels of *E. coli* O157:H7 and *E. coli* in cattle fed WDGS.



## Determine the role of windborne bioaerosols in the transport of *E. coli* O157:H7 in and from cattle production environments.

Recent *E. coli* O157:H7 outbreaks linked to the consumption of spinach and lettuce have focused attention on cattle as potential sources of contamination, and fueled the need for information regarding *E. coli* O157:H7 dissemination from cattle production. Guidelines provided in the Leafy Greens Marketing Agreement propose an interim guidance distance of 400 feet between CAFOs and leafy green crops, but there is a lack of science supporting this guidance.

- Determine if *E. coli* O157:H7 can be transferred by dust or wind from cattle production environments to leafy green produce crops.
- Determine the impacts of environmental conditions and proximity on the transmission of *E. coli* O157:H7 by dust or wind from cattle production environments to leafy green produce crops.
- Determine the impacts of environmental conditions and proximity on the density of flies and *E. coli* O157:H7-positive flies in a leafy green produce crop.



## Develop feedlot pen surface treatments to reduce pathogen occurrence and levels in beef cattle.

Feedlot surface material is a reservoir of *E. coli* O157:H7 in the production environment and a source of this pathogen for transmission to cattle, soil, food crops, and water.

Hypothesis: Treatments that reduce this pathogen in feedlot surface material will reduce *E. coli* O157:H7 colonization of cattle, reduce *E. coli* O157:H7 hide contamination, and reduce the risk of environmental contamination with this pathogen.

- Determine the role of environmental persistence in feedlot surface material in persistence and transmission of *E. coli* O157:H7 in cattle.
- Determine the effects of antimicrobial amendments or treatments of feedlot surface material on the numbers and persistence of *E. coli* and *E. coli* O157:H7 on the feedlot pen surface and the prevalence of *E. coli* O157:H7 in cattle.



## Determine the influence of various crop- and wood-based bedding materials on *E. coli* levels in manure/bedded packs of cattle deep-bedded monoslope facilities.

Cattle producers are using deep-bedded cattle barns for a variety of reasons including improved animal performance and ease of manure management compared to open lot feedlots. However, there is little available information regarding the management of these facilities to reduce nuisance emissions, including odor emissions, greenhouse gases, and pathogens.

- Crop-based: Corn stalks, soybean stubble, wheat straw, switch grass, ground corn cobs
- Wood-based: Shredded paper, wood shavings, sawdust



## Develop minimally managed composting formats to improve pathogen inactivation from bovine feedlot manure.

Foodborne illnesses linked to produce consumption have brought attention to livestock manure composts as contamination sources.

In our previous work, some replicate piles of unturned, unamended stockpiled manure heated to high temperatures that were maintained for long periods ( $>50^{\circ}\text{C}$  for 5 to 6 weeks). Proposed experiments will further define composting parameters associated with high sustained temperatures in stockpiled bovine feedlot manure, as a means of developing recommendations for feedlot operators to reduce the risk of pathogen transmission from this material.



Thanks for your time and attention.

